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NATIONAL DAM INSPECTION PROGRAM. W. H. WALKER DAM - MOUNTAIN LA--ETC(U)
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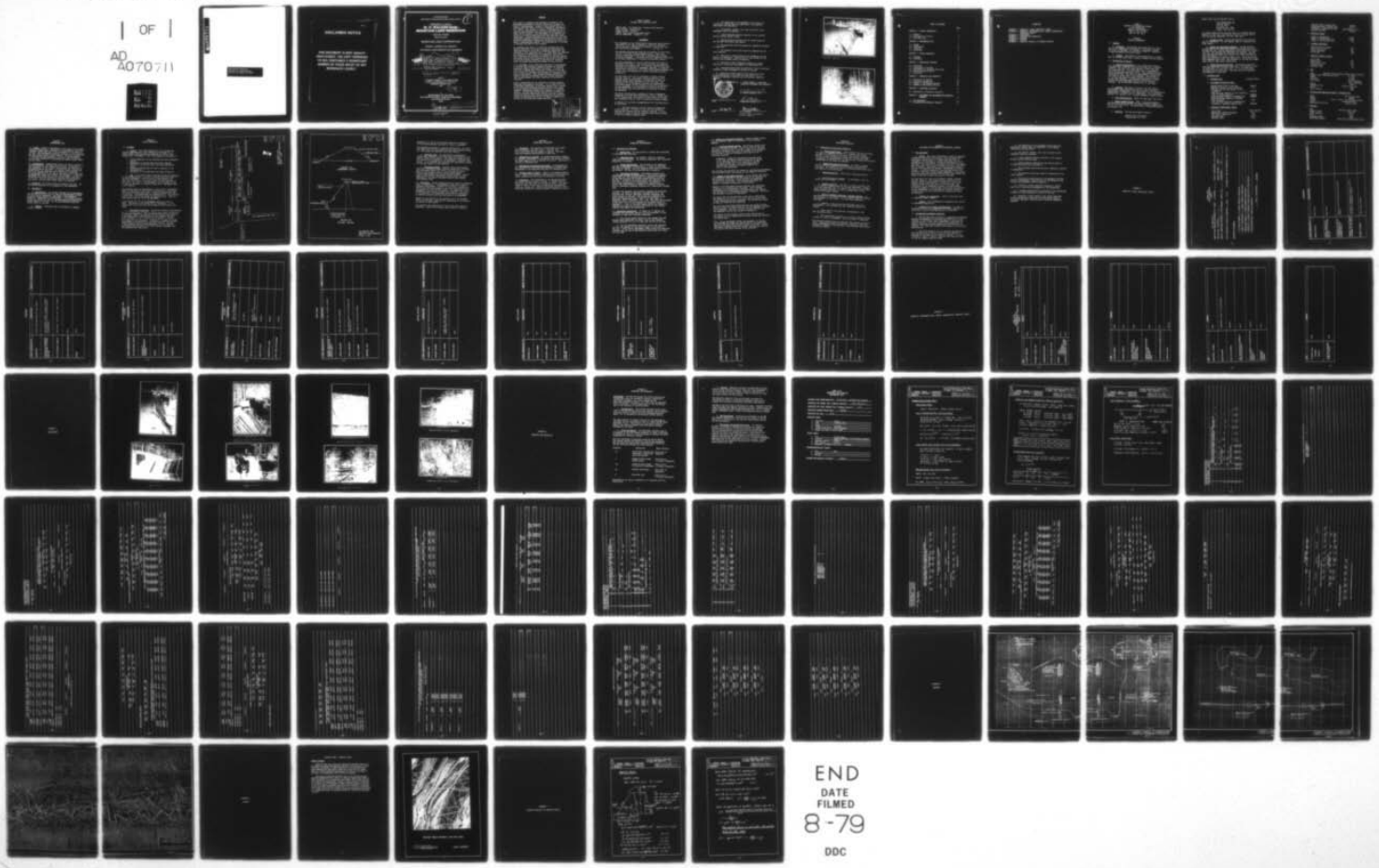

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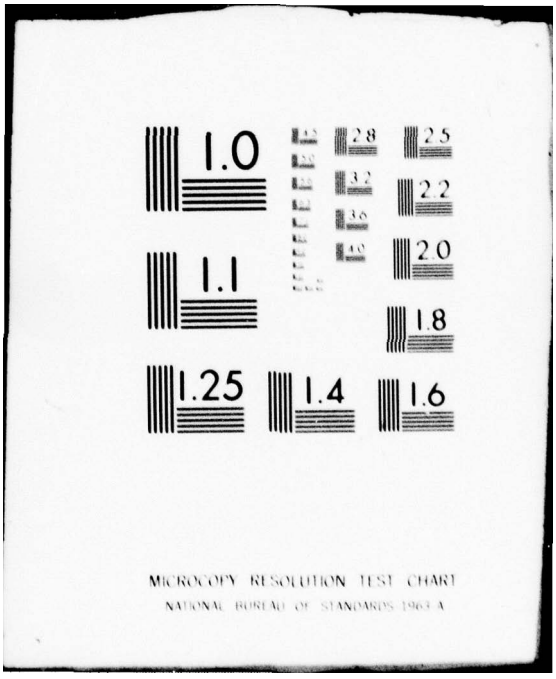
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NATIONAL BUREAU OF STANDARDS 1963-A

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POTOMAC RIVER BASIN

WEST BRANCH OF CONOCOCHEAGUE CREEK, FRANKLIN COUNTY

PENNSYLVANIA
W. H. WALKER DAM–
MOUNTAIN LAKE RESERVOIR

NDS ID NO. PA-00325

DER ID NO. 28-37

MOUNTAIN LAKE CORPORATION

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

Prepared by

L. ROBERT KIMBALL and ASSOCIATES
CONSULTING ENGINEERS and ARCHITECTS
EBENSBURG, PENNSYLVANIA
15931

90p.

For

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

MARCH 1979

411059

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM: W.H. Walker Dam - Mountain Lake Reservoir
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Franklin
STREAM: West Branch Conocoheague Creek
DATE OF INSPECTION: November 1, 1978

ASSESSMENT

The assessment of W.H. Walker Dam is based upon visual observations made at the time of inspection, review of available records and data, hydrologic and hydraulic computations, and past operational performance. → to pg 1

The existing spillway and reservoir are capable of controlling only 9% of the PMF (Probable Maximum Flood). Based upon criteria established by the Corps of Engineers the spillway is termed inadequate. A detailed study and remedial modifications should begin immediately to increase the spillway capacity.

The earth embankment is in poor condition and is in need of maintenance and repair. The concrete spillway and abandoned powerhouse are deteriorating. No stability analyses have been conducted on the gravity or embankment sections. A stability analysis was conducted for this study using assumed parameters and a water level corresponding to 50% PMF indicated structural instability.

For this dam it will not be sufficient to merely increase spillway capacity. The present spillway structure is not adequate either hydraulically or structurally to pass the spillway design flood (50% PMF) for this size dam. The combination of the inadequate spillway, the questionable structural adequacy of the spillway section and the potential for the embankment to be overtopped by storms in excess of 9% PMF dictate that this structure be classified as unsafe non-emergency.

The above classification is defined by Corps of Engineers guidelines as "a dam with deficiencies of such a nature that, if left uncorrected, could result in the failure of the dam with subsequent loss of lives or substantial property damage".

In addition to the above recommendations the following should be instituted.

1. The water ponded at the toe should be drained and a weir installed. If there is flow, the flow should be measured and recorded and the turbidity observed. If flow increases or water is turbid a detailed study should be made at once and remedial measures taken.

2. The vegetation on the embankment slopes should be selectively removed under the supervision of an engineer experienced with dam safety.

3. All gullies, erosion, ruts, and low points on the embankment should be repaired.

4. A more detailed stability analysis of the concrete gravity section should be made.

5. Riprap should be repaired and new riprap placed on the upstream slope where none exists.

6. The powerhouse facilities should be completely repaired or dismantled.

7. The reservoir drain pipe should be inspected and the valve repaired.

8. The crack or deterioration in the emergency spillway should be investigated. Deterioration of the concrete in the spillway and abutments should be repaired.

9. Institute a formal inspection program on a yearly basis with a consultant knowledgeable in dam engineering.

10. A warning system should be developed to warn downstream residents of high discharges or failure of the dam.

11. Institute a rapid closure of the outlet works pipe at the upstream end in the event the pipe should rupture, creating an emergency condition and for periodic inspection purposes.

SUBMITTED BY: L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS

COMMONWEALTH OF PENNSYLVANIA
Registered
PROFESSIONAL
R. JEFFREY KIMBALL
ENGINEER
NO. 26275-E

R. Jeffrey Kimball

R. Jeffrey Kimball, P.E.

3-16-79
Date

K. Chuang

Kuang-hwei Chuang, P.E.

23 Apr 79
Date

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

Overview of concrete spillway and abandoned power house from right abutment.

Overview of embankment section along crest from left abutment.

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APPENDICES

PHASE I
NATIONAL DAM INSPECTION PROGRAM
W.H. WALKER DAM
MOUNTAIN LAKE RESERVOIR
NDS I.D. NO. PA 325
DER I.D. NO. 28-37

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life and property.

1.2 Description of Project.

a. Dam and Appurtenances. W.H. Walker Dam, Mountain Lake Reservoir, consists of an earthfill dam with a concrete corewall. The dam is 500 feet long and 21 feet high from the downstream toe. The downstream slope is approximately 2H:1V and the upstream slope 1.5H:1V. The upstream slope has riprap protection. The crest is approximately 12 feet wide and forms an access road to the spillway. The spillway is a 175 feet long concrete gravity overflow section located at the right abutment. An abandoned powerhouse is located between the earth embankment section and the concrete spillway. The outlet works consists of a 30 inch pipe.

b. Location. The dam is located on the West Branch Conocoheague Creek, approximately one half mile southeast of Fannettsburg, Pennsylvania. The dam is shown on the Fannettsburg, Pennsylvania 7.5 minute U.S.G.S. Quadrangle. The coordinates are N40° 3.5' and W77° 49.5' in Metal Township, Franklin County.

c. Size Classification. Small (21 feet high, 184 Ac-ft).

d. Hazard Classification. High. Downstream exposure indicates that should the dam fail severe property damage and loss of life would occur. For description of downstream exposure see Section 3.1e.

e. Ownership. The dam was formerly owned by:

Mountain Lake Corporation
Fannettsburg, PA 17221

Several years ago the dam was sold to:

Eric Fredericksen and
James N. Nelson
P.O. Box 1511
Rockville, MD 20850
Phone: 301-762-7429

The former owners report that they have only received partial payment for the sale. The Franklin County Courthouse reports that the Lincoln Campsites, Inc. pay the taxes.

f. Purpose of Dam. The dam and reservoir are currently used for recreation. It was formerly used for recreation and power supply.

g. Design and Construction History. The dam was built in 1929-1930 by the Lower Path Valley Presbyterian Church for recreational use. During construction state inspectors visited the site. The designer and contractor are unknown. One year later the dam was raised one foot and the slopes flattened to meet the original 2H:1V design slopes. At a later time the power plant was installed to generate electricity. These facilities were abandoned about 1965. The ownership of the dam has changed hands several times since construction.

h. Normal Operating Procedure. No operating functions have been performed for quite a few years. The reservoir level is maintained at the spillway crest. It is not known when the drain line was last used. The power plant was abandoned approximately 14 years ago.

1.3 Pertinent Data.

a. Drainage Area. 59 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site	Unknown
Warm water outlet at pool elevation	N/A
Drainage pipe low pool outlet at pool elevation	Unknown
Gated spillway capacity at pool elevation - size of turbine penstock	Unknown
Gated spillway capacity at maximum pool	Unknown
Ungated spillway capacity at maximum pool elevation	6181
Total spillway capacity at maximum pool elevation - Reliable capacity 6181	Unknown

c. Elevation (USGS Datum) (Feet).

Top of dam	734.0 Low spot
Maximum pool design surcharge	734.5
Full flood control pool	N/A
Recreation pool	730.0
Spillway crest	730.0

Upstream invert drainage pipe	Unknown
Downstream invert drainage pipe	717.6
Streambed at centerline of dam	Approximately 712.6
Maximum tailwater	Unknown

d. Reservoir (feet).

Length of maximum pool	11,000
Length of recreational pool	9,000
Length of flood control pool	N/A

e. Storage (acre-feet).

Recreation pool (normal)	184
Flood control pool	N/A
Design surcharge	550
Top of dam	550

f. Reservoir Surface (acres).

Top of dam	113
Maximum pool	113
Flood control pool	N/A
Recreation pool	60
Spillway crest	60

g. Dam.

Type	Earthfill with concrete gravity overflow section
Length (crest including spillway)	724 feet
Height	21 feet
Top width	12 feet
Side slopes	1.5H:1V Upstream 2H:1V Downstream
Zoning	None
Impervious core	Concrete core wall
Cutoff	None
Grout curtain	None

h. Diversion and Regulating Tunnel - Drainage Pipe.

Type	30" concrete pipe
Length	Unknown
Closure	Gate or valve - only controls visible
Access	Downstream outlet
Regulating facilities	Control valve

i. Spillway.

Type	Concrete gravity ogee
Length of weir	175 feet
Crest elevation	730.0
Gates	None
Upstream channel	Lake
Downstream channel	West Branch Conococheague Creek

SECTION 2
ENGINEERING DATA

2.1 Design. Review of information in the files of the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER) showed that very little information is available on the dam. The information available consisted of one topographic map and several typical cross sections. No design summary or calculations were available. The only other information in the files consisted of correspondence between former owners and the State.

2.2 Construction. Construction data on the dam is limited to several letters to the owner from the State. Inspection of the foundation for the corewall and spillway was conducted by representatives of the State. At several places concrete was placed before the inspector could examine the foundation. After the completion of the dam it was noted by the State that the embankment slopes were steeper than designed. In 1932 the embankment was raised one foot by placing planks vertically on the crest near the downstream slope and filling behind it with earth. The new crest sloped toward the upstream.

2.3 Operation. No formal records of operation are kept. No records are available on the operation of the powerhouse.

2.4 Evaluation.

a. Availability. The several drawings and correspondence was provided by the Division of Dams and Encroachments, Bureau of Water Quality Management, Department of Environmental Resources, Commonwealth of Pennsylvania. Two adjacent property owners, Mr. Howard Ott and Mr. William Hunnicutt discussed the recent history of the dam. Mr. Ott was associated with the former owners of the dam.

b. Adequacy. Sufficient data is available to complete a Phase I report.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of W.H. Walker Dam, Mountain Lake Reservoir, was conducted by personnel of L. Robert Kimball and Associates accompanied by a former owner (Howard Ott) on November 1, 1978. The inspection consisted of:

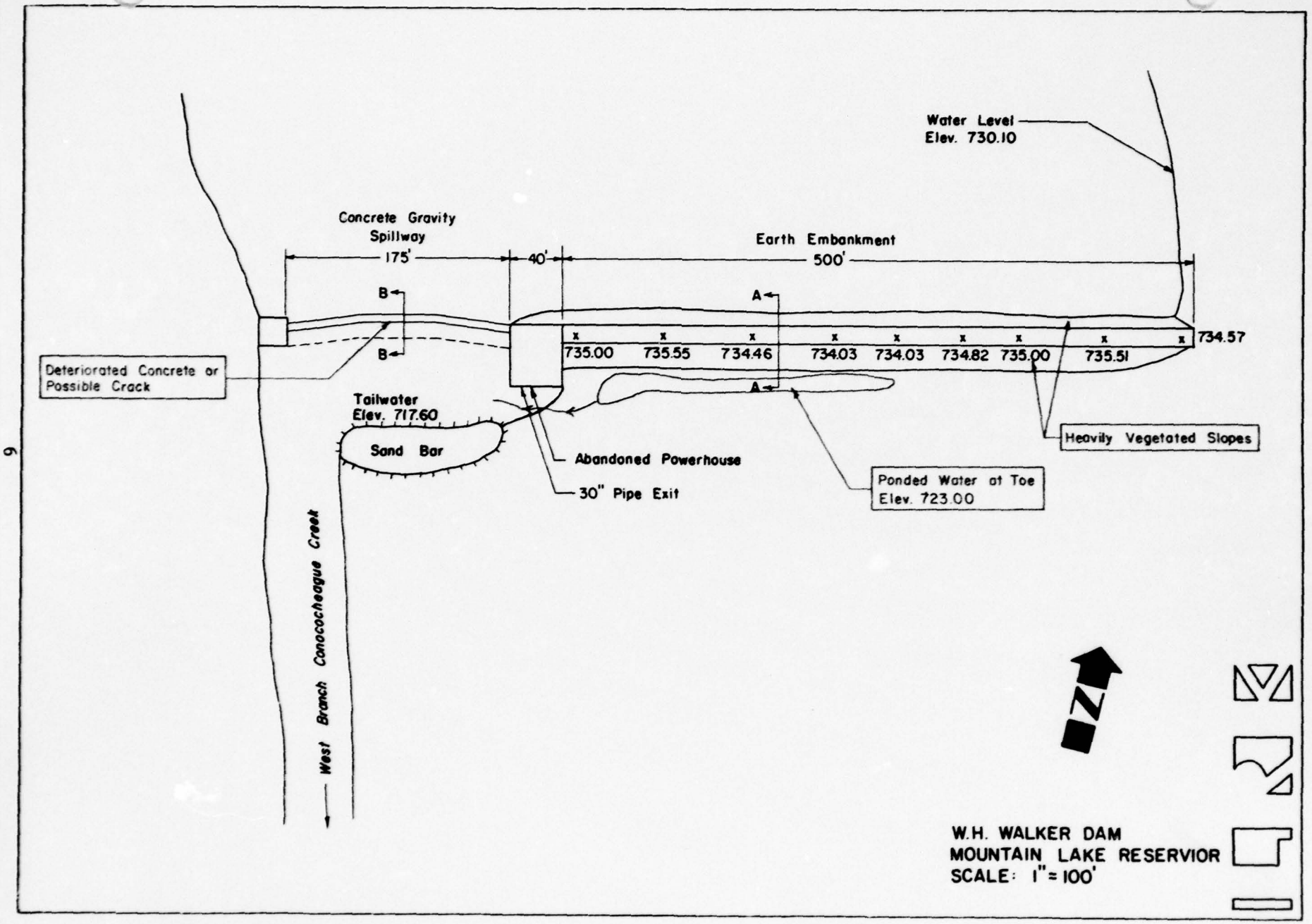
1. Visual inspection of the retaining structure, abutments, and toe.
2. Examination of the spillway facilities, exposed portions of any outlet works, and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

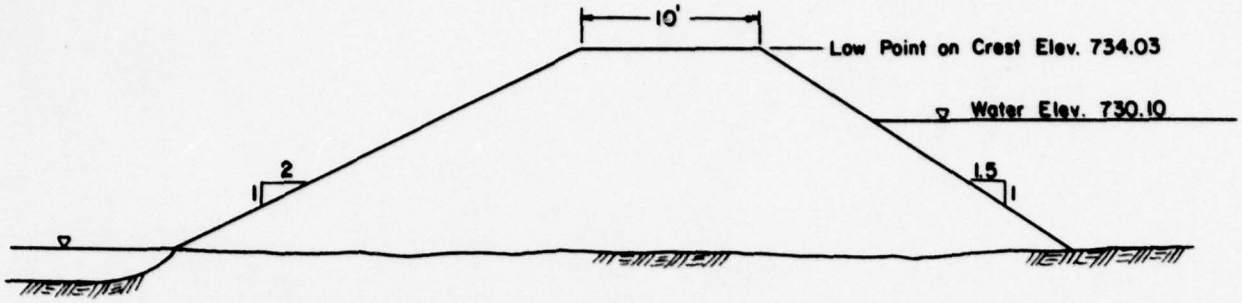
b. Dam. From a brief survey conducted during the inspection it was determined that a low spot is present near the center of the earth embankment. This low point is approximately 150 feet long and one-half to one foot lower than the remainder of the crest. The crest of the embankment has been deeply rutted by vehicles and water is laying in these ruts. See pages 6 and 7 for location.

The upstream slope was approximately 1.5H:1V with a considerable amount of vegetation in the form of trees growing on the slope. Some areas of erosion were noted. Riprap was present over most of the slope. The downstream slope averaged 2H:1V. The slope was covered with a very thick growth of trees and brush. There is some erosion near the toe of the embankment.

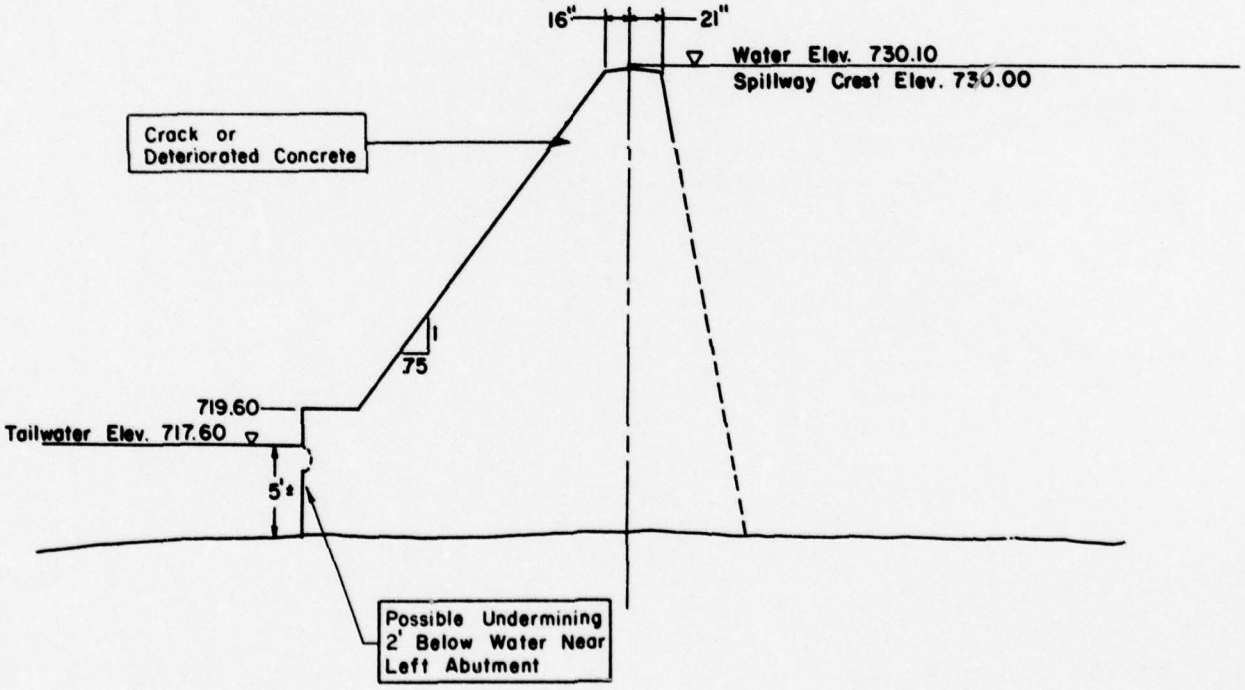
At and beyond the toe of the embankment there is a pond of water. The source of this water was not determined. At the western end of the pond water was flowing from the pond to the creek.

c. Appurtenant Structures. During the inspection approximately 0.1 foot of water was flowing over the spillway, making examination of the crest impossible. Near the center portion of the spillway a horizontal crack or deterioration of the concrete was noted. Close examination of this feature was not possible. During Hurricane Agnes in 1972, it was reported that the sand bar beyond the plunge pool was deposited. In addition, it appears that some undermining of the spillway toe may have occurred. The level of the tailwater did not permit examination of this feature. Considerable deterioration of the left concrete abutment with the powerhouse has taken place.


Water Level
Elev. 730.10
Concrete Gravity
Spillway
175'
40'
Earth Embankment
500'
B
B
A
A
735.00
735.55
734.46
734.03
734.03
734.82
735.00
735.51
734.57
Deteriorated Concrete or
Possible Crack
Tailwater
Elev. 717.60
Sand Bar
Abandoned Powerhouse
30" Pipe Exit
Heavily Vegetated Slopes
Ponded Water at Toe
Elev. 723.00
West Branch Conococheague Creek
W.H. WALKER DAM
MOUNTAIN LAKE RESERVIOR
SCALE: 1" = 100'



SECTION A-A
EMBANKMENT SECTION



SECTION B-B
SPILLWAY SECTION

W.H. WALKER DAM
MOUNTAIN LAKE RESERVIOR
SCALE: 1" = 10'

Examination of the 30 inch drawdown pipe was not possible. It is not known whether the gate (or valve) is operable.

The abandoned powerhouse is severely deteriorated. The overshot wheel used for power generation has water seeping through it. The turbine and generator have been removed.

d. Reservoir Area. The watershed is predominantly covered with woodland on the steep slopes and farmland on the flatter slopes and floodplain. The reservoir slopes are very flat and are not considered to be susceptable to massive landslides. It is believed that siltation has considerably reduced the storage capacity of the reservoir.

e. Downstream Channel. The West Branch Conococheague Creek has a moderately wide floodplain downstream of the dam. The creek makes several 90° turns in the next few miles. Homes in the village of Metal, located approximately 5 miles downstream,may be affected during flooding. Several homes in Fort Loudon, Pennsylvania,located about 10 miles downstream of the dam,are situated along the West Branch Conococheague Creek.

3.2 Evaluation. Visual inspection did not reveal any immediate signs of instability. The embankment slopes are in need of preventive maintenance. Erosion of the slopes, placement of additional riprap and repairs to the ruts on the crest should be performed in the very near future. The vegetation on the embankment slopes should be selectively removed. The source of the ponding at the downstream toe should be investigated. No stability analysis has been performed on the embankment.

Repairs to the concrete on the spillway and at the abutment should be performed. The possible undermining of the spillway toe should be investigated.

The condition and operability of the 30 inch pipe should be evaluated. Leaks in the overshot wheel should be repaired.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. The reservoir is maintained at as high a level as possible (spillway crest). The last time the 30 inch drain line was opened is unknown. The powerhouse was abandoned approximately 14 years ago.

4.2 Maintenance of the Dam. No planned maintenance schedule is utilized. Maintenance of the dam has been severely lacking. The owners employ no one to perform maintenance. Maintenance of the dam is considered poor.

4.3 Maintenance of Operating Facilities. No maintenance of the operating facilities has been performed in several years. Maintenance of the operating facilities is considered poor.

4.4 Warning System in Effect. There is no warning system in effect. There is no operator residing at the site and no permanent communication facilities are available at the dam.

4.5 Evaluation. The maintenance of the dam and operating facilities has been severely lacking. It appears that no maintenance has been done for at least 10 years. The owners reside at least 75 miles from the dam and do not employee anyone at the dam site. There is no warning system to warn downstream residents of high discharges or failure of the dam.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. No calculations or design data pertaining to hydrology were available.

b. Experience Data. No rainfall, runoff or reservoir level data was available. The spillway reportedly has functioned adequately in the past.

c. Visual Observations. The concrete in the emergency spillway is beginning to deteriorate. A crack or joint near the crest has opened. The left abutment shows some deterioration and erosion. The toe of the spillway may be undercut.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway. The PMF is that hypothetical flow induced by the most severe combination of precipitation, infiltration losses, and concentration of runoff at a specific location that is considered reasonably possible for a particular drainage area.

To assist the engineer, and provide a standard for hydrologic analyses, the Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed briefly in Appendix D. A copy of the Users Manual should be obtained by engineers who need more precise definitions of the computer program requirements and methodology.

5.2 Evaluation Assumptions. To enable us to complete the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. For the dam breach analysis it was assumed that dam failure would begin when the water level in the reservoir reached elevation 737.0 or 3.0 feet over the top of the dam.

2. For the overtopping analysis a top of dam elevation of 734.5 was assumed for the entire length of the crest of 600 feet. Field survey measurements taken during the inspection indicate that the top of dam elevation varies from 734.0 feet to 735.6 feet.

5.3 Summary of Overtopping Analysis. Complete summary sheets from the computer output are presented in the hydrologic appendix.

a. Spillway Adequacy Rating. The spillway design flood (SDF) for this dam is 50% PMF. The SDF is based on the size and hazard classification of the dam. Based on the following definition provided by the Corps of Engineers the spillway for this dam is rated as inadequate as a result of our hydrologic analysis.

> Inadequate - Large and intermediate size dams which do not pass the PMF but which do pass 50% of the PMF or all size dams which do not pass 50% of the PMF but where failure due to the overtopping does not significantly increase the hazard potential for loss of life downstream.

The spillway and reservoir are capable of controlling approximately 9% of the PMF without overtopping the dam (based on low spot).

5.4 Summary of Dam Breach Analysis. As the subject dam cannot satisfactorily pass 50% of the PMF (based on our analysis) it was necessary to perform a breach analysis and downstream routing of the flood wave. This analysis determines the degree of increased flooding due to dam failure.

Results of the Dam Breach analysis indicate that downstream flooding is not significantly increased. Since flooding downstream is not significantly increased due to dam failure the spillway is not considered seriously inadequate. Therefore, this spillway is rated as "inadequate".

The water level in the reservoir at the time of dam failure was assumed to be at 737.0' (3.0' over the top of dam) based on the evaluating engineers judgement. The 40% PMF was routed through the reservoir and downstream.

The flood wave was routed downstream with and without failure. Failure of both the concrete section and the embankment sections were considered. The worst failure (concrete section) and the embankment failure are included in Appendix D.

The results of this analysis indicate that failure due to overtopping will not significantly increase downstream potential for loss of life.

Note: Future development within the watershed, at the dam, or downstream may change the characteristics and assumptions made for this study and different results are likely. Future development downstream may also greatly increase the potential for loss of life due to failure of the structure.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Visual observation did not reveal any signs of immediate instability. However, the erosion gullies, ruts and water on the crest, and possible seepage at the toe if left untreated may become more serious with time. In addition the deterioration of the spillway concrete and possible undermining at toe should be repaired.

b. Design and Construction Data. No record of design data or stability analysis for the original structure was available. No construction data is available which would affect the stability of the structure.

c. Operating Records. There are no operating records.

d. Post-Construction Changes. The embankment crest was raised one foot in 1932.

e. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analysis has been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading.

f. Check of Stability Analysis - Concrete Section. An approximation of the stability of the concrete overflow spillway was performed for this study. The following assumptions were made:

1. Geometry of the section was developed from field measurements. The upstream face and foundation details are unknown.

2. Water level in the reservoir corresponded to 50% PMF (elevation 738.2).

3. The conventional analysis for a vertical section having a width of 1 foot is considered. The arch action is neglected.

The analysis revealed that the resultant lies outside the middle third. Computations indicate structural instability under the conditions assumed for this analysis. More detailed and accurate analyses are needed.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual observations, review of available information, hydrologic calculations, and past-operational performance indicate that W.H. Walker Dam's spillway is inadequate. The spillway is capable of handling only 9% of the PMF without overtopping. No stability analysis has been performed. The source of the ponding at the toe of the embankment is unknown. The amount of erosion and undercutting at the toe of the spillway is unknown. Maintenance is severely lacking. A stability analysis of the spillway section conducted for this report using assumed parameters, cross-section and field conditions indicates the resultant lies outside the middle third with a water level equal to 50% PMF.

For this dam it will not be sufficient to merely increase spillway capacity. The present spillway structure is not adequate either hydraulically or structurally to pass the spillway design flood (50% PMF) for this size dam. The combination of the inadequate spillway, the questionable structural adequacy of the spillway section and the potential for the embankment to be overtopped by storms in excess of 9% PMF dictate that this structure be classified as unsafe non-emergency.

b. Adequacy of Information. There is sufficient data to complete a Phase I Report.

c. Urgency. The recommendations suggested below should be implemented immediately.

d. Necessity for Further Investigations. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required.

7.2 Recommendations/Remedial Measures.

1. Perform additional studies by a registered professional engineer knowledgeable in dam design and inspection for modification of the spillway and/or embankment to increase the spillway capacity. This study should begin immediately and remedial modifications begun immediately after the study is complete. The study must consider both hydraulic and structure modifications.

2. The water ponded at the toe should be drained and a weir installed and if there is flow, the flow should be measured and recorded and the turbidity observed. If flow increases or water is turbid a detailed study should be made at once and remedial measures taken.

3. The vegetation on the embankment slopes should be selectively removed under the supervision of an engineer experienced with dam safety.

4. All gullies, erosion, ruts, and low points on the embankment should be repaired.

5. A more detailed stability analysis of the concrete gravity section should be made.

6. Riprap should be repaired and new riprap placed on the upstream slope where none exists.

7. The powerhouse facilities should be completely repaired or dismantled.

8. The reservoir drain pipe should be inspected and the valve repaired.

9. The crack or deterioration in the emergency spillway should be investigated. Deterioration of the concrete in the spillway and abutments should be repaired.

10. Institute a formal inspection program on a yearly basis with a consultant knowledgeable in dam engineering.

11. A warning system should be developed to warn downstream residents of high discharges or failure of the dam.

12. Institute a rapid closure of the outlet works pipe at the upstream end in the event the pipe should rupture, creating an emergency condition and for periodic inspection purposes.

APPENDIX A

CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM W.H. Walker Dam / Mountain Lake Reservoir COUNTY Franklin STATE Pennsylvania ID# PA 325

TYPE OF DAM Earthfill HAZARD CATEGORY High

DATE(s) INSPECTION November 1, 1978 WEATHER Sunny, cool TEMPERATURE 60°

POOL ELEVATION AT TIME OF INSPECTION 730.1 M.S.L. TAILWATER AT TIME OF INSPECTION 717.6 M.S.L.

INSPECTION PERSONNEL:

R. Jeffrey Kimball - L. Robert Kimball & Associates

James T. Hockensmith - L. Robert Kimball & Associates

Kuang hwei Chuang - L. Robert Kimball & Associates

Howard Ott - adjacent landowner (associated with former owners)

William Hunnicutt - adjacent landowner

James T. Hockensmith RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None noted.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noted.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Erosion on both upstream and downstream slopes.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment all right. Low point in center of embankment section.	
RIPRAP FAILURES	Some riprap missing.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Thick trees and brush on both slopes.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Left abutment alright. Concrete severely deteriorated at left spillway abutment at powerhouse.	
ANY NOTICEABLE SEEPAGE	None noted. Pond at toe, source unknown.	
STAFF GAUGE AND RECORDER	None.	
DRAINS	None.	

CONCRETE/MASONRY DAMS
SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Not visible due to flow over spillway.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Deterioration of concrete at left abutment.	
DRAINS	Unknown.	
WATER PASSAGES	Unknown.	
FOUNDATION	Not visible.	

CONCRETE/MASONRY DAMS
SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Crack or deterioration in center near top of spillway.	
STRUCTURAL CRACKING	See above.	
VERTICAL AND HORIZONTAL ALIGNMENT	Vertical - O.K. Horizontal - constructed with 2 bends.	
MONOLITH JOINTS	Unknown.	
CONSTRUCTION JOINTS	Unknown.	
STAFF GAUGE OR RECORDER	Unknown.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	30 inch blowoff line, condition unknown.	
INTAKE STRUCTURE	Type and condition unknown.	
OUTLET STRUCTURE	Pipe outlets directly into plunge pool - condition O.K.	
OUTLET CHANNEL	Plunge pool and stream channel.	
EMERGENCY GATE	None.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Appeared all right.Some deterioration.	
APPROACH CHANNEL	None.	
DISCHARGE CHANNEL	Plunge pool and stream channel. Possible undercutting of spillway toe.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Wide and flat with no obstructions or debris.	
SLOPES	Flat and stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	4 homes - 5 miles. 10 homes - 10 miles.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Very flat.	
SEDIMENTATION	Appears to be considerable siltation.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER		

APPENDIX B

CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION, PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM W.H. Walker Dam

ID# PA 325

ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	None.
CONSTRUCTION HISTORY	Some correspondence in PennDER files.
TYPICAL SECTIONS OF DAM	PennDER files.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	None.
RAINFALL/RESERVOIR RECORDS	None.

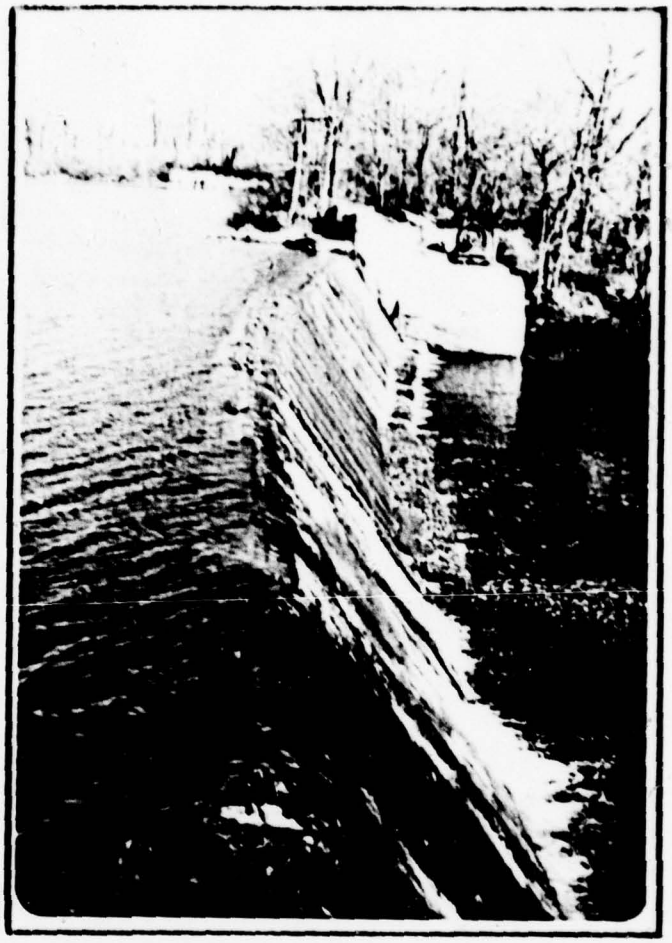
ITEM	REMARKS
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None.
POST-CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Embankment raised 1 foot,powerhouse.
HIGH POOL RECORDS	Unknown.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Unknown.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	None.
OPERATING EQUIPMENT PLANS & DETAILS	None.

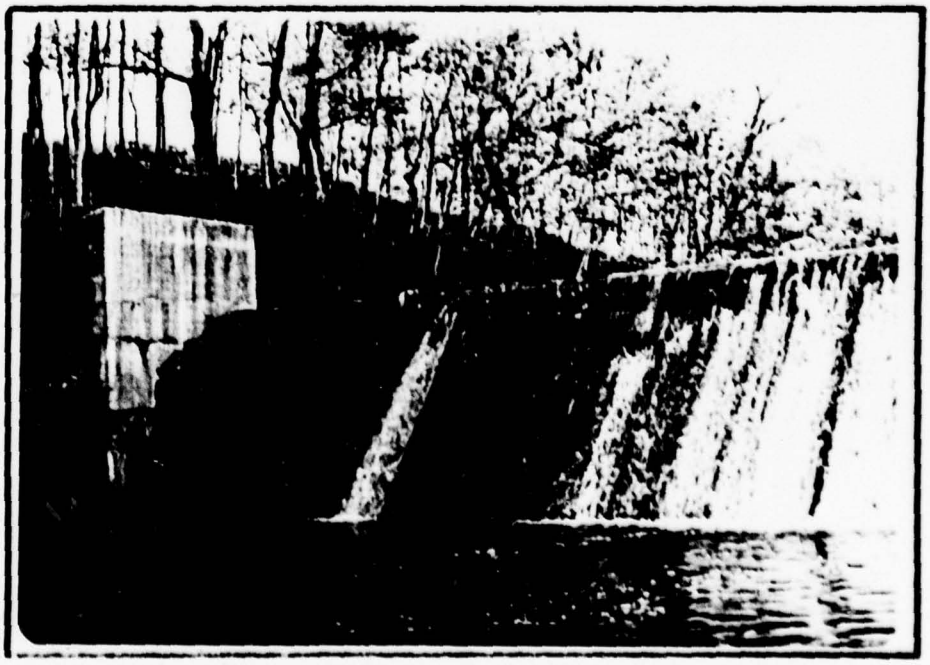
APPENDIX C

PHOTOGRAPHS



Photograph No. 1

Concrete spillway and abandoned hydroelectric power station.

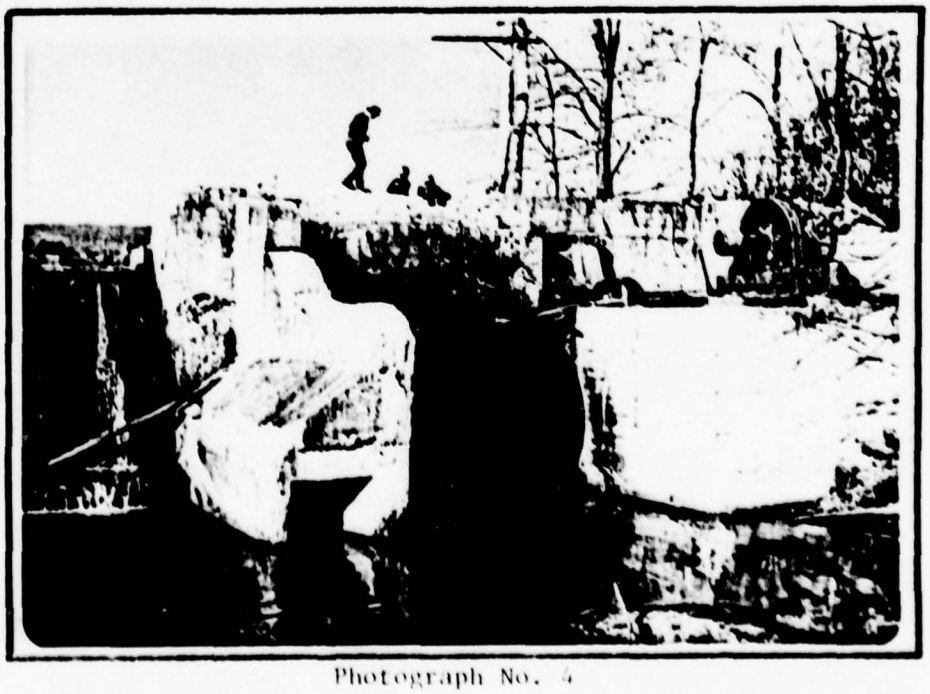


Photograph No. 2

Right abutment.

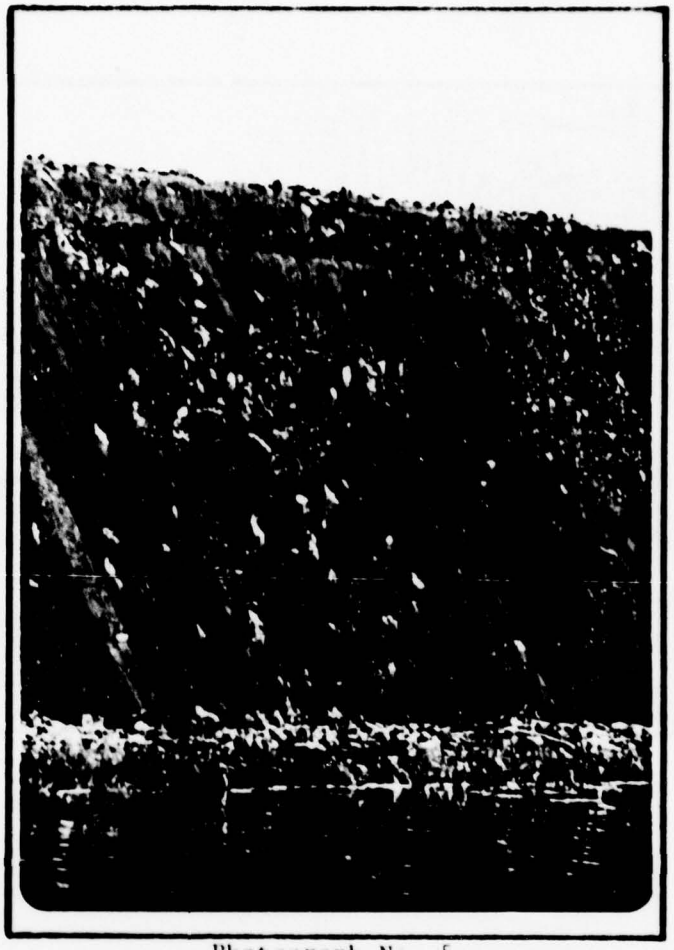
Photograph No. 3

Junction of spillway and power house - Deteriorated concrete.



Photograph No. 4

Abandoned power house.

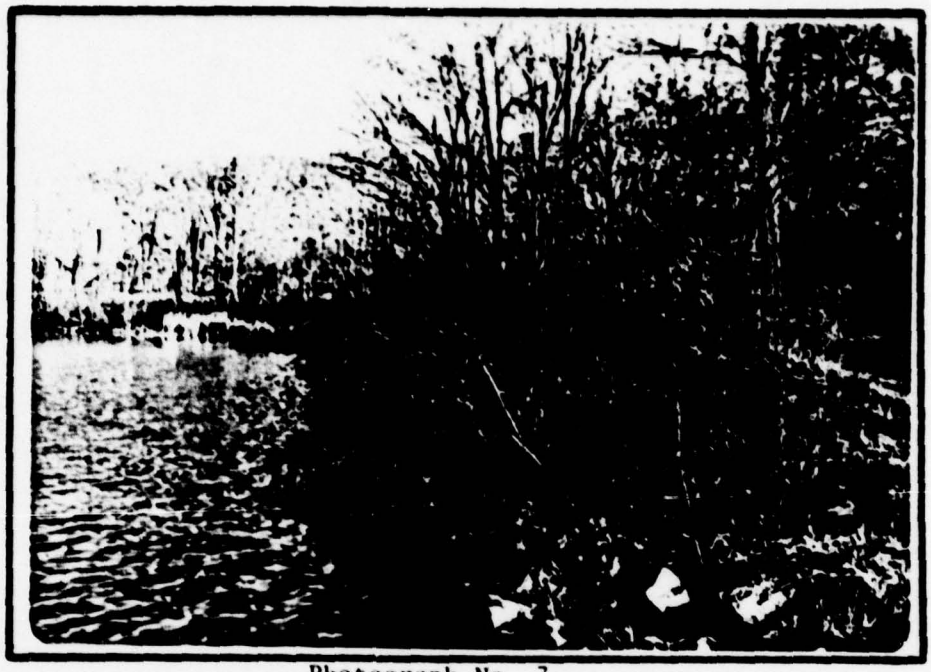


Photograph No. 5

Deteriorated spillway concrete.

Photograph No. 6

Immediate downstream channel.



Photograph No. 7

Upstream slope of earth embankment.

Photograph No. 8

Downstream slope of earth embankment.

APPENDIX D

HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology. The dam overtopping and breach analyses were accomplished using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analyses is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 33 prepared by the National Weather Service.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters their definition and how they were obtained for these analysis.

Parameter	Definition	Where Obtained
C_t	Coefficient representing variations of watershed slope and storage	From Corps of Engineers*
L	Length of main stream channel, miles	From U.S.G.S. 7.5 minute topographic
L_{ca}	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
C_p	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

3. Routing. Reservoir routing is accomplished by using Modified Plus routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation discharge relationship.

Storage in the pool area is defined by an area - elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping. Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach and Downstream Routing. The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer with given input assumptions) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre-and post-failure water depths are calculated at locations where cross-sections are input.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 58 sq miles - woodland and farmland

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 730.0 (184 Ac-ft)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 734.0

SPILLWAY CREST:

a. Elevation 730.0
b. Type Concrete ogee
c. Width
d. Length 175 feet
e. Location Spillover Right abutment
f. Number and Type of Gates None

OUTLET WORKS:

a. Type 30 inch pipe
b. Location Under powerhouse, left spillway abutment
c. Entrance inverts Unknown
d. Exit inverts 717.6
e. Emergency draindown facilities Unknown

HYDROMETEOROLOGICAL GAUGES:

a. Type None
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME MOUNTIAN LAKE DAM
I.D. NUMBER PA. 28-37
SHEET NO. 1 OF 3
BY DTM DATE 8-1-79

MOUNTIAN LAKE DAM

DRAINAGE AREA

AREA = 58 SQ.MI. (FROM U.S.G.S. QUAD.)

UNIT HYDROGRAPH PARAMETERS

DAMSITE LOCATED IN ZONE 32. FROM CORPS OF ENGINEERS, BALTIMORE DISTRICT REGIONAL STUDY.

$C_p = 0.75$, $C_t = 1.90$ {FROM C.O.E. BALTIMORE DIST.}

$L = 21.0$ MILES, $L_{ca} = 11.7$ MILES {FROM U.S.G.S. QUAD.}

$t_p = C_t (L \cdot L_{ca})^{0.3} = 1.90 (21.0 \times 11.7)^{0.3}$

$t_p = 1.90 (5.21) = 9.9$ HRS. (SNYDERS LAG (t_p) IN HRS.)

LOSS RATE AND BASE FLOW PARAMETERS

AS RECOMMENDED BY CORPS OF ENGINEERS, BALTIMORE DISTRICT.

STRTL = 1 INCH
CNSTL = 0.05 IN./HR.
STRTQ = 1.50 CFS/SQ.MI.
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.00

PROBABLE MAXIMUM STORM

FROM H.R. NO. 33

P.M.P. (INDEX RAINFALL - 23.6 INCHES)

$R_6 = 96\%$, $R_{12} = 104\%$, $R_{24} = 115\%$, $R_{48} = 127\%$

ELEVATION-AREA-CAPACITY RELATIONSHIP

AT SPILLWAY CREST ELEV. 730.0', AREA = 60 ACRES
A) INITIAL STORAGE = 184 ACRE. FT.

FROM U.S.G.S. QUAD.
A) ELEV. 730.0' SURFACE AREA = 60 ACRES
B) ELEV. 740.0' SURFACE AREA = 220 ACRES
C) ELEV. 760.0' SURFACE AREA = 622 ACRES

FROM CONIC METHOD FOR RESERVOIR VOLUME. FLOOD HYDROGRAPH PACKAGE (HEC-1). DAM SAFETY VERSION (USERS MANUAL).

$H = 3V/A = 3(184\ A.F)/60\ \text{ACRES} = 9.2$ FT.

ELEV. AT CAPACITY EQUALS ZERO;
730.0 - 9.2 = 720.8 (FT.)

ELEV. (FT.)	720.8	730	732	736	740	744	748	760
AREA (Ac.)	0	60	85	140	220	297	382	622

DISCHARGE-RATING CURVES

DISCHARGE RATING CURVES WERE DETERMINED WITH HEC-1 BASED ON THE FOLLOWING PARAMETERS:

$Q = CLH^{3/2}$

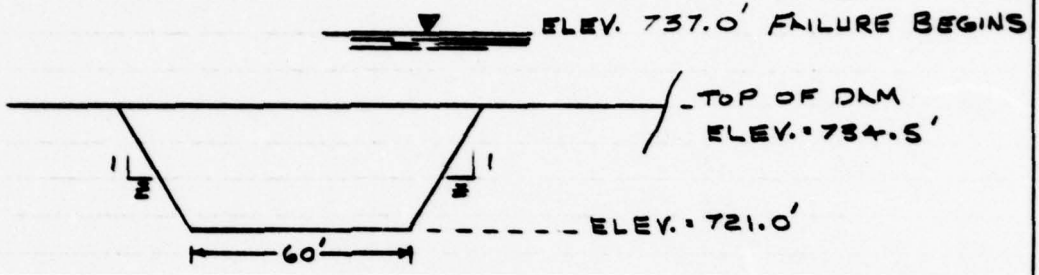
	WEIR LENGTH L (FT.)	C
SPILLWAY	175	3.7 (OGEE)
DAM	600	3.05

SPILLWAY CREST EL.= 730', TOP OF DAM EL. = 734.5'

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME MOUNTIAN LAKE DAM
I.D. NUMBER PA. 28-37
SHEET NO. 3 OF 3
BY OTM DATE 2-1-79

DAM BREACH PARAMETERS



	PLAN 1 Embankment Fail	PLAN 2 Conc. Spillway Fail
RATIO OF PMF	= 0.4	0.4
BREACH WIDTH (BRWID)	= 60'	60'
SIDE SLOPE OF BREACH (Z)	= 0.5	0
FAILURE TIME (TFAIL)	= 1 HR.	0.4 hr.
ELEV. FAILURE BEGINS (FAILEL)	= 737.0'	737.0

CHANNEL ROUTING

CHANNEL CROSS SECTIONS OBTAINED FROM U.S.G.S. QUADS.

CHANNEL (MANNING'S n), QN(2) = 0.05

OVERBANK (MANNING'S n), QN(1) = QN(3) = .06

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  25 SEP 78
**********
    1                A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
    2                A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF MOUNTJAM LAKE DAM
    3                A3       RATIOS OF PMF ROUTED THROUGH THE RESERVOIR     PA. 28-37
    4                B    288        0       10        0        0        0        0        0       -4        0
    5                B1     5
    6                J      1        6        1
    7                J1   0.1      0.2      0.3      0.4      0.5        1
    8                K      0        1                                            1
    9                K1       INFLOW TO RESERVOIR
   10                M      1        1       58                58                                 1
   11                P              23.6       96      104      115      127
   12                T                                                          1.0     0.05
   13                W    9.9     0.75
   14                X   -1.5     -.05      2.0
   15                K      1        2                                            1
   16                K1       ROUTE THROUGH RESERVOIR
   17                Y                                        1        1
   18                Y1     1                                                    184
   19                SA     0       60       85      110      117      140      178      220      255      297
   20                SA   340      382      425      622
   21                SE 720.8      730      732      734    734.5      736      738      740      742      744
   22                SE   746      748      750      760
   23                SS   730      175      3.7      1.5
   24                SD 734.5     3.05      1.5      600
   25                K     99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1
ROUTE HYDROGRAPH TO 2
END OF NETWORK

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 25 SEP 78
****

RUN DATE 79/01/16.
TIME 18.31.43.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF MOUNTIAN LAKE DAM
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR PA. 28-37

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	-4	0
			JOPER	NMT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 6 LRTIO= 1
RTIOS= .10 .20 .30 .40 .50 1.00

****

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	58.00	0.00	58.00	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.60	96.00	104.00	115.00	127.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .854

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 9.90 CP= .75 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 9.83 HOURS, CP= .74 VOL= .82

7.	28.	59.	96.	138.	185.	235.	288.	343.	401.
461.	523.	587.	652.	718.	785.	854.	923.	993.	1064.
1135.	1207.	1280.	1353.	1426.	1499.	1573.	1647.	1721.	1795.
1869.	1943.	2017.	2091.	2165.	2237.	2306.	2371.	2432.	2489.
2543.	2593.	2640.	2684.	2723.	2760.	2793.	2823.	2850.	2874.
2894.	2912.	2926.	2937.	2945.	2950.	2951.	2950.	2945.	2937.
2926.	2911.	2892.	2870.	2844.	2813.	2777.	2736.	2686.	2625.
2555.	2485.	2417.	2352.	2288.	2225.	2165.	2106.	2049.	1993.
1939.	1886.	1834.	1785.	1736.	1689.	1643.	1598.	1555.	1512.
1471.	1431.	1392.	1354.	1317.	1281.	1247.	1213.	1180.	1148.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.58	23.09	2.49	2132605.
										650.)(	587.)(	63.)(60388.65)	

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	184.	0

SURFACE AREA=	0.	60.	85.	110.	117.	140.	178.	220.	255.	297.
	340.	382.	425.	622.						
CAPACITY=	0.	184.	328.	523.	579.	772.	1089.	1486.	1961.	2513.
	3149.	3871.	4677.	9881.						
ELEVATION=	721.	730.	732.	734.	735.	736.	738.	740.	742.	744.
	746.	748.	750.	760.						

CREL	SPWID	COOW	EXPW	ELEVL	COQL	CAREA	EXPL
730.0	175.0	3.7	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
734.5	3.1	1.5	600.

PEAK OUTFLOW IS 5449. AT TIME 48.00 HOURS

PEAK OUTFLOW IS 11136. AT TIME 48.00 HOURS

PEAK OUTFLOW IS 16724. AT TIME 48.00 HOURS

PEAK OUTFLOW IS 22306. AT TIME 48.00 HOURS

PEAK OUTFLOW IS 27884. AT TIME 48.00 HOURS

PEAK OUTFLOW IS 55752. AT TIME 48.00 HOURS

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 .40	RATIO 5 .50	RATIO 6 1.00
HYDROGRAPH AT	1	58.00	1	5620.	11241.	16861.	22482.	28102.	56204.
		(150.22)		(159.15)(	318.31)(	477.46)(	636.61)(	795.77)(	1591.53)(
ROUTED TO	2	58.00	1	5449.	11136.	16724.	22306.	27884.	55752.
		(150.22)		(154.30)(	315.35)(	473.57)(	631.63)(	789.59)(	1578.72)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	730.00	730.00	734.50
STORAGE	184.	184.	579.
OUTFLOW	0.	0.	6181.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	734.14	0.00	538.	5449.	0.00	48.00	0.00
.20	735.68	1.18	729.	11136.	4.17	48.00	0.00
.30	736.63	2.13	863.	16724.	5.67	48.00	0.00
.40	737.43	2.93	991.	22306.	6.33	48.00	0.00
.50	738.16	3.66	1117.	27884.	7.00	48.00	0.00
1.00	741.18	6.68	1757.	55752.	8.67	48.00	0.00

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  25 SEP 78
**********
    1          A1       RATIO OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
    2          A2       DOWNSTREAM CONDITION DUE TO OVERTOP  MOUNTAIN LAKE DAM PA 28-37
    3          A3       Plans 1 and 2 assumes breach   Plan 3 assumes no breach
    4          B    288       0        10        0         0         0         0         0        -4         0
    5          B1     5
    6          J      3        1         1
    7          J1   .4
    8          K      0        1                                                  1
    9          K1       INFLOW TO RESERVOIR
   10          M      1        1        58                  58                                      1
   11          P              23.4      96       104       115       127
   12          T                                                                 1.0      0.05
   13          W    9.9      0.75
   14          X   -1.5      -.05      2.0
   15          K      1        2                                                  1
   16          K1       ROUTE THRU RESERVOIR
   17          Y                                          1         1
   18          Y1     1                                                         184
   19          SA     0       60        85       110       117       140       178       220       255       297
   20          SA   360      382       425       622
   21          SE 720.8      730       732       734     734.5       736       738       740       742       744
   22          SE   746      748       750       760
   23          SS   730      175       3.7       1.5
   24          SD 734.5     3.05       1.5       600
   25          SB  60.      .5        721.       1.       730.      737.
   26          SB  60.                721.       .4       730.      737.
   27          SB  60.                721.       5.       730.      739.
   28          K      1        3                                                  1
   29          K1       CHANNEL ROUTING -MOD PULS REACH 2-3
   30          Y                                          1         1
   31          Y1     1
   32          Y6   .06      .05       .06      717.      750.     8000.     .0001
```

```
33          Y7        760.    200.    740.    600.    720.    900.    717.    910.    717.
34          Y71350.   720.    1850.   740.    2650.   760.
35          K     1       4                                       1
36          K1        CHANNEL ROUTINT -MOD PULS REACH 3-4
37          Y                                       1       1
38          Y1    1
39          Y6  .06   .05     .06     684.    730.    10400.  .0032
40          Y7        740.    250.    720.    500.    700.    1000.   684.    1010.   684.
41          Y71440.   700.    1700.   720.    1550.   740.
42          K     1       5                                       1
43          K1        CHANNEL ROUTING -MOD PULS REACH 4-5
44          Y                                       1       1
45          Y1    1
46          Y6  .06   .05     .06     675.    710.    4200.   .0002
47          Y7        720.    300.    700.    600.    680.    900.    675.    1000.   675.
48          Y71050.   680.    1450.   700.    1550.   720.
49          K     99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
ROUTE HYDROGRAPH TO	3
ROUTE HYDROGRAPH TO	4
ROUTE HYDROGRAPH TO	5
END OF NETWORK	

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 25 SEP 78
****

RUN DATE 79/01/16.
TIME 12.08.43.

RATIO OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
DOWNSTREAM CONDITION DUE TO OVERTOP MOUNTJAM LAKE DAM PA 28-37
PLAN 1 ASSUMES BREACH. PLAN 2 ASSUMES NO BREACH

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0.	-4	0

IOPER	MVT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 3 NRTIO= 1 LRTIO= 1

RTIOS= .40

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	58.00	0.00	58.00	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.60	96.00	104.00	115.00	127.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .854

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 9.90 CP= .75 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 9.83 HOURS, CP= .74 VOL= .82

7.	28.	59.	96.	138.	185.	235.	288.	343.	401.
461.	523.	587.	652.	718.	785.	854.	923.	993.	1064.
1135.	1207.	1280.	1353.	1426.	1499.	1573.	1647.	1721.	1795.
1869.	1943.	2017.	2091.	2165.	2237.	2306.	2371.	2432.	2489.
2543.	2593.	2640.	2684.	2723.	2760.	2793.	2823.	2850.	2874.
2894.	2912.	2926.	2937.	2945.	2950.	2951.	2950.	2945.	2937.
2926.	2911.	2892.	2870.	2844.	2813.	2777.	2736.	2686.	2625.
2555.	2485.	2417.	2352.	2288.	2225.	2165.	2106.	2049.	1993.
1939.	1886.	1834.	1785.	1736.	1689.	1643.	1598.	1555.	1512.
1471.	1431.	1392.	1354.	1317.	1281.	1247.	1213.	1180.	1148.

0
END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.58	23.09	2.49	2132605.
										(650.)(587.)(63.)(60388.65)			

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	184.	0

SURFACE AREA=	0.	60.	85.	110.	117.	140.	178.	220.	255.	297.
	340.	382.	425.	622.						
CAPACITY=	0.	184.	328.	523.	579.	772.	1089.	1686.	1961.	2513.
	3149.	3871.	4677.	9881.						
ELEVATION=	721.	730.	732.	736.	735.	736.	738.	740.	742.	744.
	746.	748.	750.	760.						

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
730.0	175.0	3.7	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
734.5	3.1	1.5	600.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
60.	.50	721.00	1.00	730.00	737.00

BEGIN DAM FAILURE AT 46.00 HOURS

PEAK OUTFLOW IS 24846. AT TIME 47.00 HOURS

OVN

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
60.	0.00	721.00	5.00	730.00	739.00

PEAK OUTFLOW IS 22306. AT TIME 48.00 HOURS

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

CHANNEL ROUTING -MOD PULS REACH 2-3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	717.0	750.0	8000.	.00010

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 760.00 200.00 740.00 600.00 720.00 900.00 717.00 910.00 717.00
1350.00 720.00 1850.00 740.00 2650.00 760.00

STORAGE	0.00	71.52	275.54	534.04	817.47	1125.83	1459.12	1817.34	2200.50
2608.58									
	3041.59	3499.54	3982.41	6490.22	5023.75	5584.90	6173.76	6790.31	7434.56
8106.52									
OUTFLOW	0.00	107.23	706.30	2036.65	3929.16	6367.89	9345.29	12863.36	16928.26
21548.56									
	26734.45	32497.10	38848.40	45800.72	53326.01	61493.09	70329.37	79846.94	90059.09
100979.79									
STAGE	717.00	718.74	720.47	722.21	723.95	725.68	727.42	729.16	730.89
732.63									
	734.37	736.11	737.84	739.58	741.32	743.05	744.79	746.53	748.26
750.00									
FLOW	0.00	107.23	706.30	2036.65	3929.16	6367.89	9345.29	12863.36	16928.26
21548.56									
	26734.45	32497.10	38848.40	45800.72	53326.01	61493.09	70329.37	79846.94	90059.09
100979.79									

MAXIMUM STAGE IS 732.7

MAXIMUM STAGE IS 732.5

MAXIMUM STAGE IS 732.3

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

CHANNEL ROUTING -MOD PULS REACH 3-4.

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME
ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	684.0	730.0	10400.	.00320

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 740.00 250.00 720.00 500.00 700.00 1000.00 684.00 1010.00 684.00
1440.00 700.00 1700.00 720.00 1550.00 740.00

STORAGE	0.00	46.45	174.25	383.38	673.86	1045.68	1498.84	2029.85	2605.01
3215.85									
	3862.37	4537.28	5229.77	5939.76	6667.24	7412.21	8174.68	8954.64	9752.09
10567.03									
OUTFLOW	0.00	388.69	2267.83	6491.26	13770.38	24740.04	39983.89	62062.34	92469.37
128113.03									
	168997.38	215411.66	266985.96	323577.17	385109.92	451530.90	522802.46	598898.71	679802.88
765505.68									

STAGE	684.00	686.42	688.84	691.26	693.68	696.11	698.53	700.95	703.37
705.79									
	708.21	710.63	713.05	715.47	717.89	720.32	722.74	725.16	727.58
730.00									
FLOW	0.00	388.69	2267.83	6491.26	13770.38	24740.04	39983.89	62062.34	92469.37
128113.03									
	168997.38	215611.66	266985.96	323577.17	385109.92	451530.90	522802.46	598898.71	679802.88
765505.48									

MAXIMUM STAGE IS 695.3

MAXIMUM STAGE IS 695.2

MAXIMUM STAGE IS 695.0

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

CHANNEL ROUTING -MOD PULS REACH 4-5

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	675.0	710.0	4200.	.00020

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 720.00 300.00 700.00 600.00 680.00 900.00 675.00 1000.00 675.00
1050.00 680.00 1450.00 700.00 1550.00 720.00

STORAGE	0.00	29.21	81.33	155.88	244.80	345.18	457.00	580.28	715.01
861.19									
	1018.82	1187.91	1368.44	1560.43	1763.41	1973.75	2190.62	2414.04	2644.00
2880.51									
OUTFLOW	0.00	153.86	629.30	1590.24	3212.64	5346.00	8000.81	11191.76	14935.93
19251.72									
	24158.27	29675.11	35821.98	42618.67	50211.30	58642.85	67740.17	77503.71	87935.29
99037.83									
STAGE	675.00	676.84	678.68	680.53	682.37	684.21	686.05	687.89	689.74
691.58									
	693.42	695.26	697.11	698.95	700.79	702.63	704.47	706.32	708.16
710.00									
FLOW	0.00	153.86	629.30	1590.24	3212.64	5346.00	8000.81	11191.76	14935.93
19251.72									
	24158.27	29675.11	35821.98	42618.67	50211.30	58642.85	67740.17	77503.71	87935.29
99037.83									

MAXIMUM STAGE IS 692.0

MAXIMUM STAGE IS 691.9

MAXIMUM STAGE IS 691.5

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .40
HYDROGRAPH AT	1	58.00 (150.22)	1	22482. (636.61)(
			2	22482. (636.61)(
			3	22482. (636.61)(
ROUTED TO	2	58.00 (150.22)	1	24846. (703.56)(
			2	25373. (718.48)(
			3	22306. (631.63)(
ROUTED TO	3	58.00 (150.22)	1	21691. (614.23)(
			2	21319. (603.68)(
			3	20655. (584.87)(
ROUTED TO	4	58.00 (150.22)	1	21162. (599.23)(
			2	20813.

			(589.35)(
		3	19884.
			(563.05)(
ROUTED TO	5	58.00	1 20268.
		(150.22)	(573.94)(
			2 20088.
			(568.82)(
			3 18982.
			(537.50)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	730.00	730.00	734.50
STORAGE	184.	184.	579.
OUTFLOW	0.	0.	6181.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.40	737.01	2.51	923.	24846.	6.33	47.00	46.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	730.00	730.00	734.50
STORAGE	184.	184.	579.
OUTFLOW	0.	0.	6181.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.40	737.01	2.51	923.	26275.	6.33	46.40	46.00

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	730.00	730.00	734.50
STORAGE	184.	184.	579.
OUTFLOW	0.	0.	6181.

RATIO OF	MAXIMUM RESERVOIR	MAXIMUM DEPTH	MAXIMUM STORAGE	MAXIMUM OUTFLOW	DURATION OVER TOP	TIME OF MAX OUTFLOW	TIME OF FAILURE

PMF	W.S.ELEV	OVER DAM	AC-FT	CFS	HOURS	HOURS	HOURS
.40	737.43	2.93	991.	22306.	6.33	48.00	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	21691.	732.7	48.00

PLAN 2 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	21319.	732.5	48.00

PLAN 3 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	20655.	732.3	48.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	21162.	695.3	48.00

PLAN 2 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	20813.	695.2	48.00

PLAN 3 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	19884.	695.0	48.00

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	20268.	692.0	48.00

PLAN 2 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	20088.	691.9	48.00

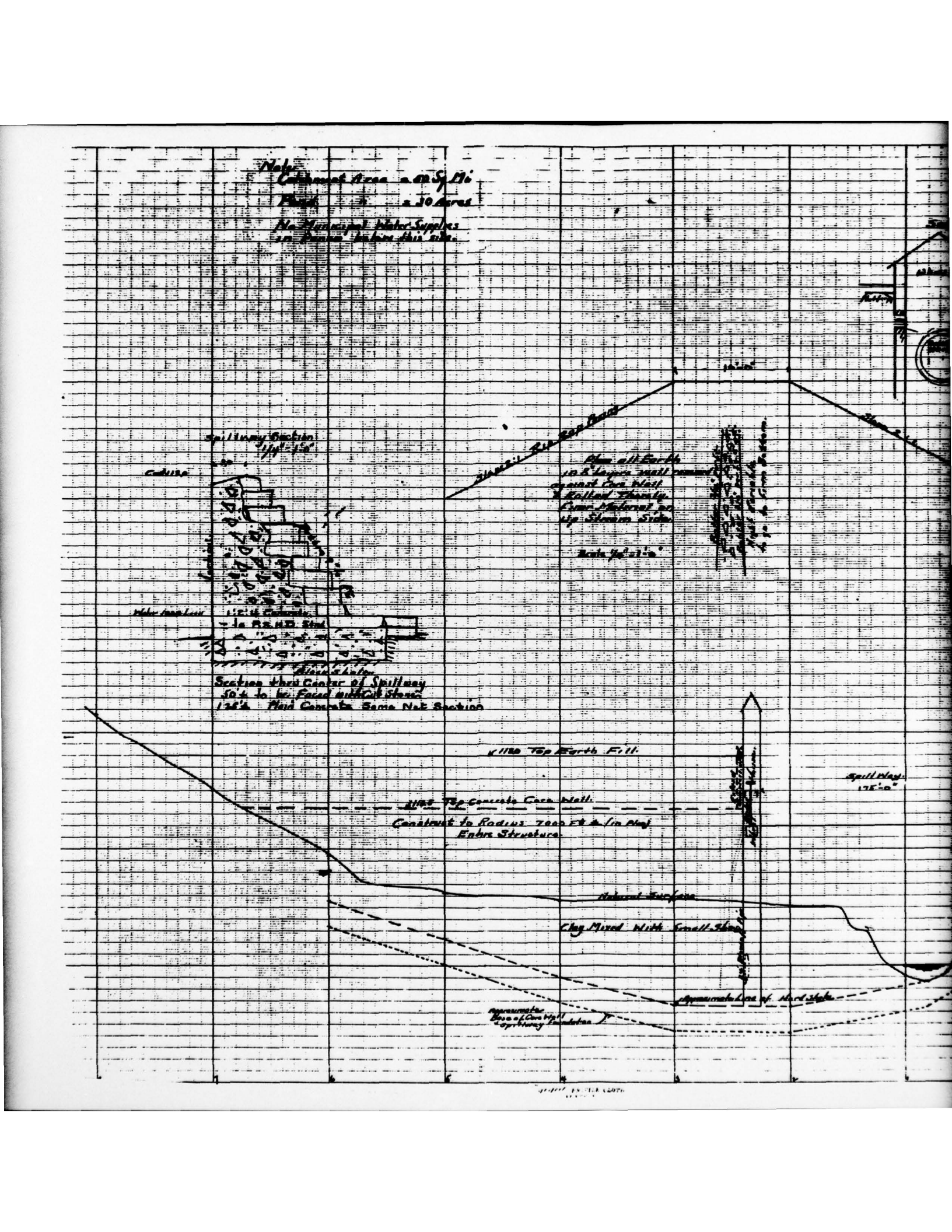
PLAN 3 STATION 5

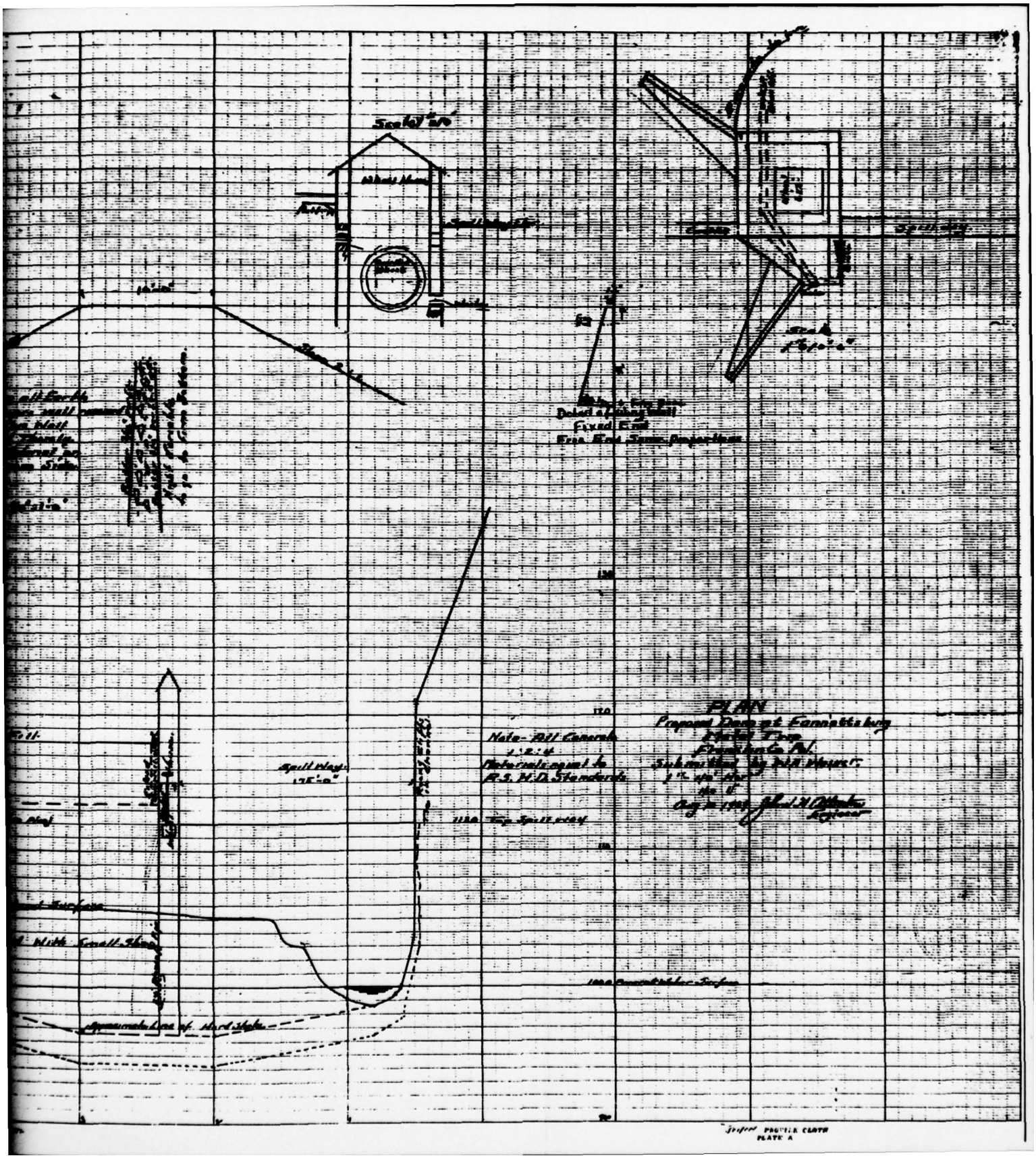
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	18982.	691.5	48.00

APPENDIX E

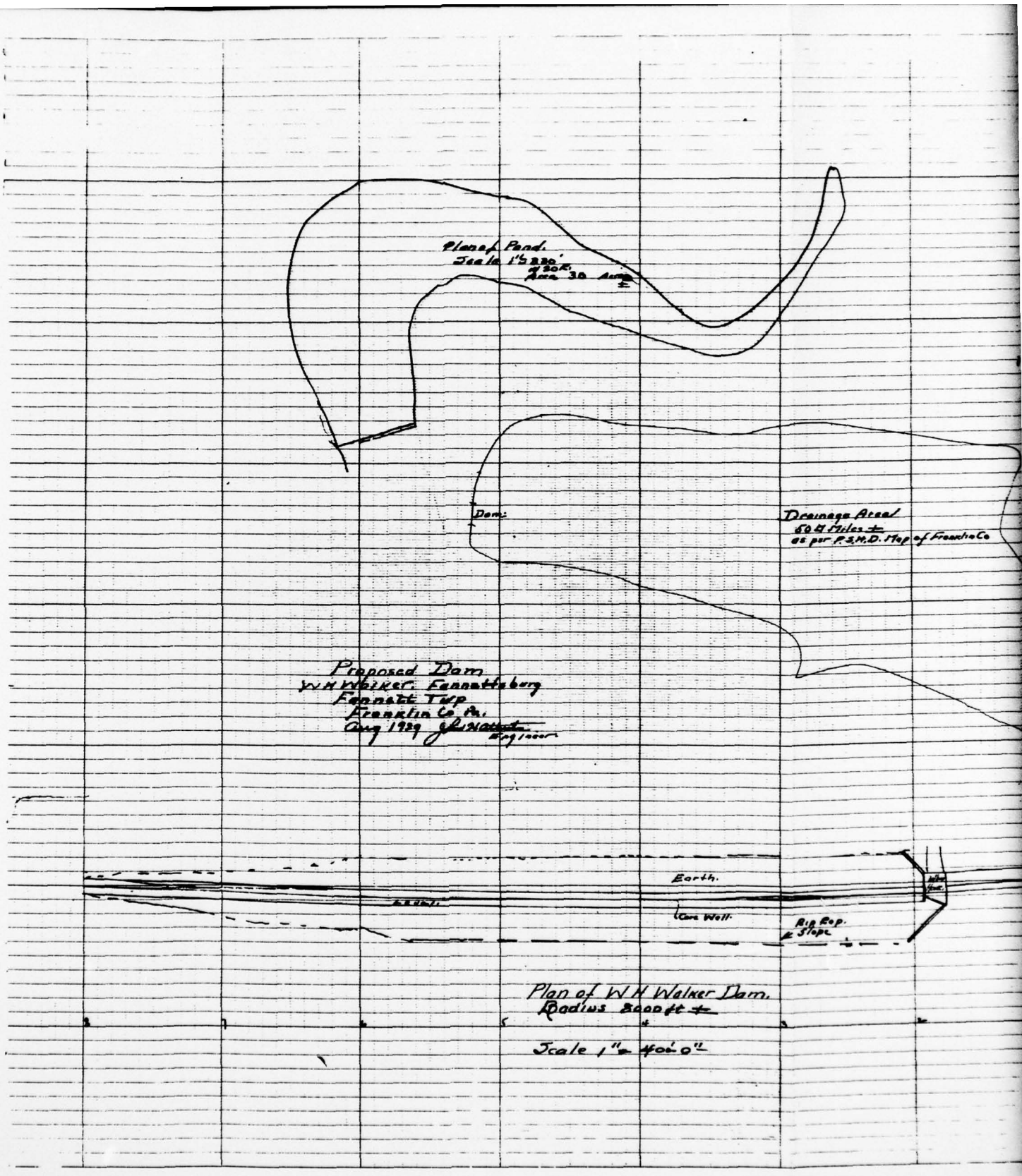
DRAWINGS

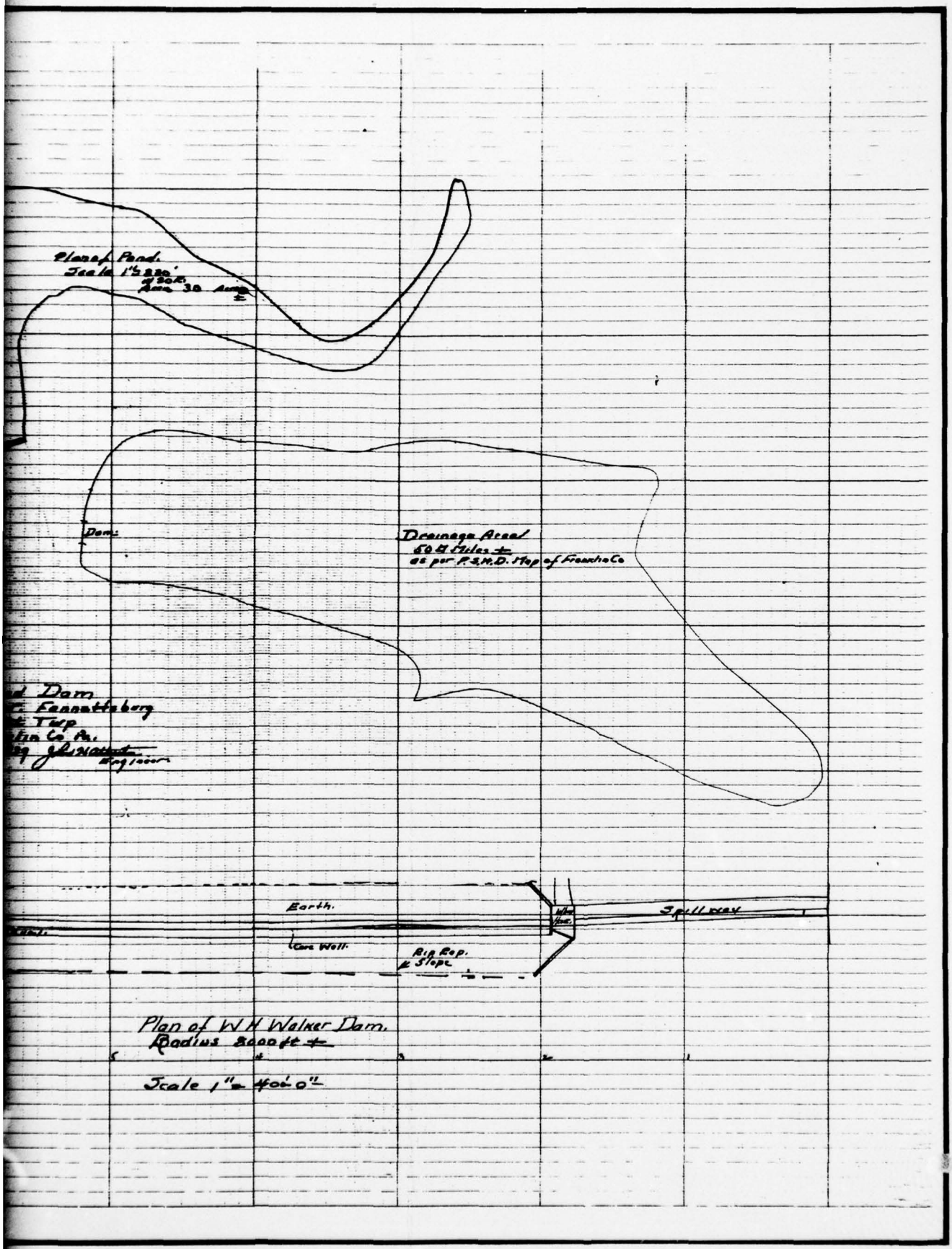
Note:
Catchment Area = 28 Sq. Mi.
Flood " = 20 Acres
No Municipal Water Supplies
are known below this site.





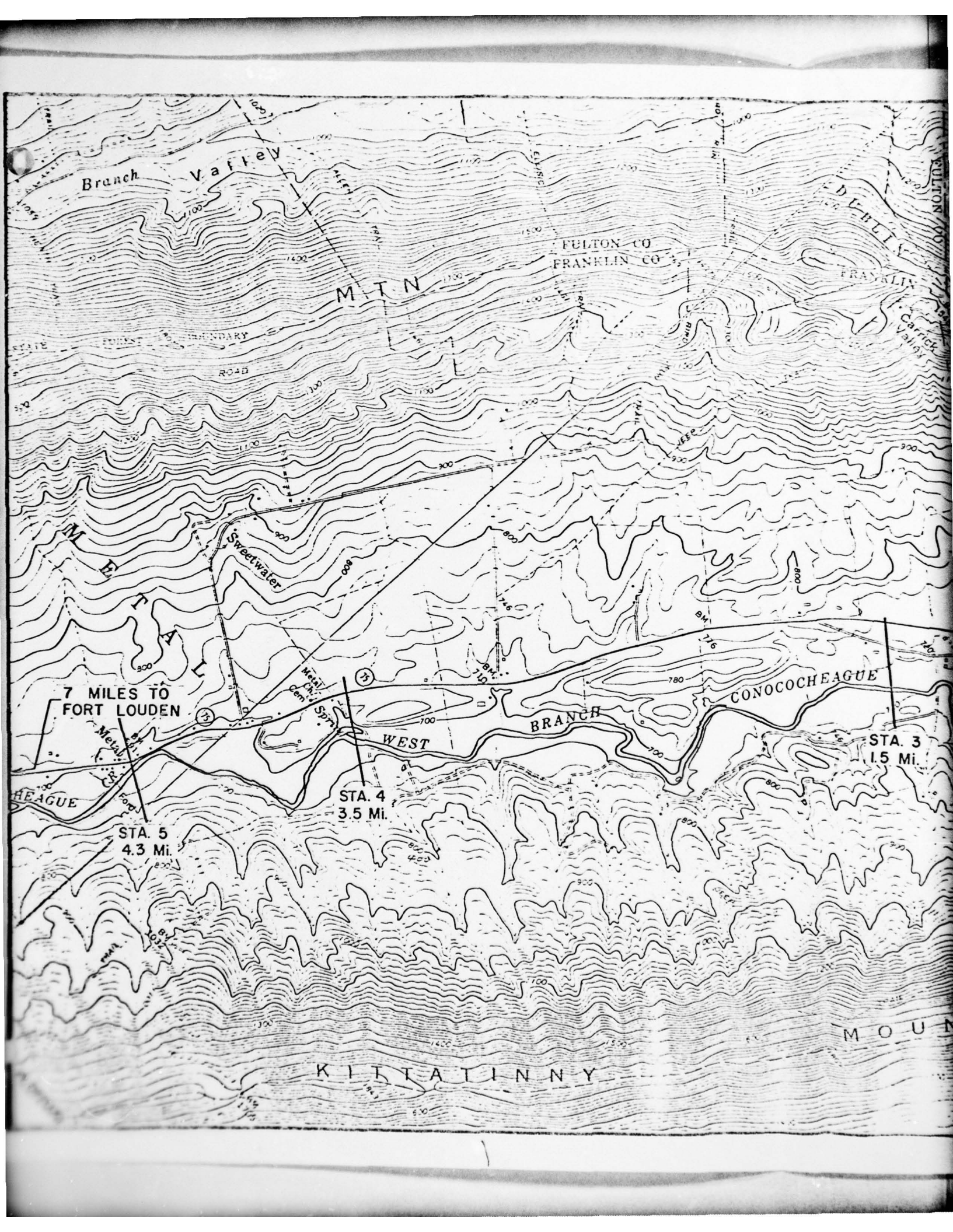
Jaffrey PROFILE CLOTH
PLATE A

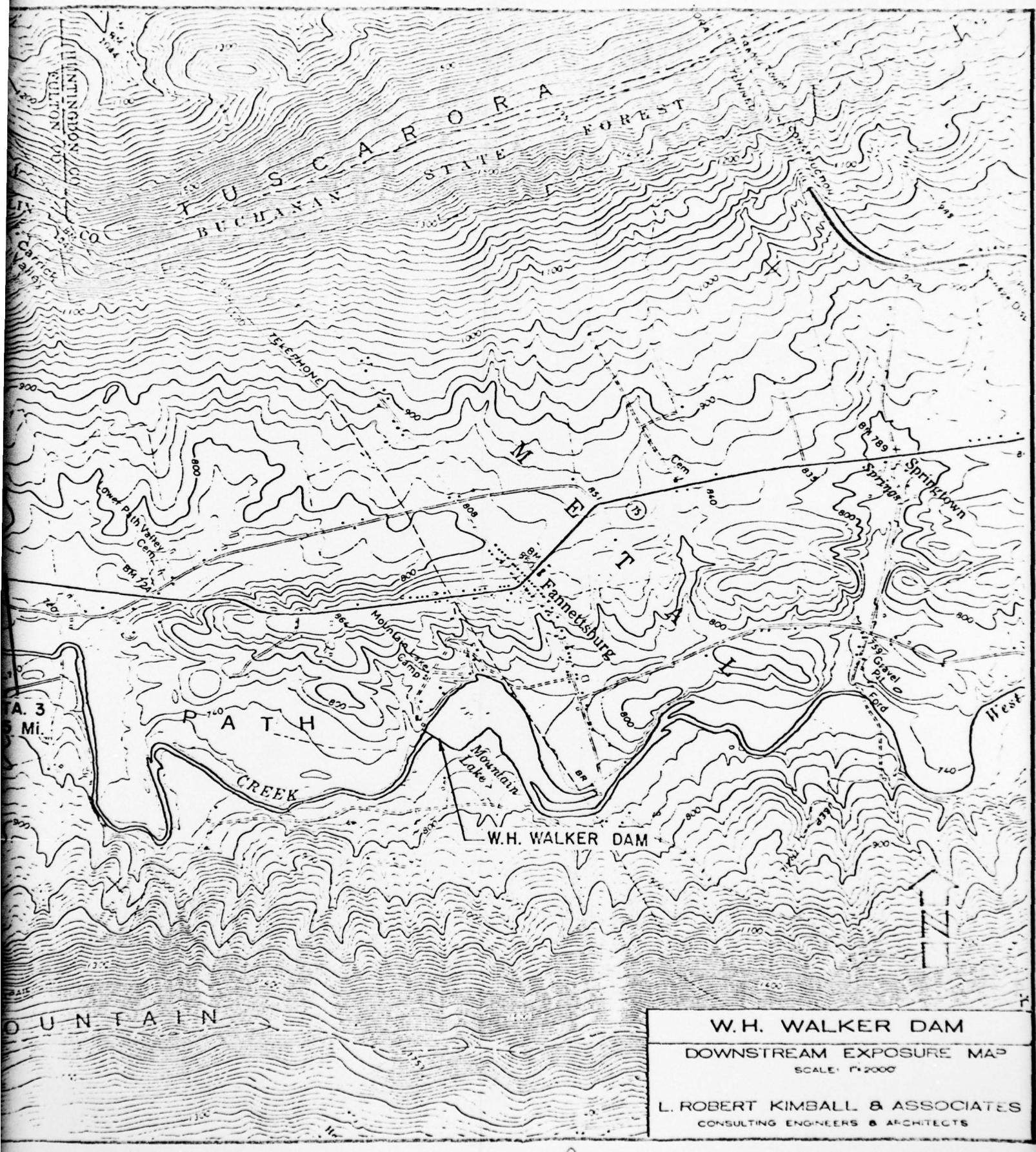

Plan of Pond.
Scale 1"=220'
Area 30 Acres ±
Dam.
Drainage Area
50.0 Miles ±
as per P.S.H.D. Map of Franklin Co.
Proposed Dam
W.H. Walker. Fannettsburg
Fannett Twp
Franklin Co Pa.
Aug 1929 John Watt
Engineer
Earth.
Core Wall.
Rip Rap
& Slope
Plan of W.H. Walker Dam.
Radius 3000 ft ±
Scale 1" = 40' 0"



L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

Figure 2


Branch Valley
M T N
FULTON CO
FRANKLIN CO
FRANKLIN
Carrick Valley
STATE FOREST BOUNDARY
ROAD
M E T A L
Sweetwater
7 MILES TO
FORT LOUDEN
Metal Ch.
Spring
WEST BRANCH
CONOCOCHEAGUE
STA. 3
1.5 Mi.
STA. 4
3.5 Mi.
STA. 5
4.3 Mi.
K I T T A T I N N Y



W.H. WALKER DAM

DOWNSTREAM EXPOSURE MAP

SCALE: 1" = 2000'

L. ROBERT KIMBALL & ASSOCIATES

CONSULTING ENGINEERS & ARCHITECTS

Figure 3

APPENDIX F

GEOLOGY

Mountain Lake - Franklin County

General Geology:

Mountain Lake lies within the Appalachian Mountain Section of the Valley and Ridge Physiographic Province. This province is characterized by moderate to steep asymmetric and overturned folds. Local shearing and high angle thrust faults may also be present. There is a fault indicated approximately one mile to the west of the lake. Its displacement and activity are unknown.

The bedrock underlying Mountain Lake is the Ordovician aged Reedsville Formation (Or). This is a dark gray shale with sandy to silty interbeds. It is moderately well bedded. The joints are abundant and well developed with a seamy to platy pattern. The spacing is variable, but with generally a small distance between fractures. It is only slightly resistant and often has a moderate to deep weathered zone which should be excavated if it is to form a foundation for a heavy structure. The joints, faults and bedding planes provide a low magnitude source of secondary porosity. The surface drainage is good.

Geologic Map of Mountain Lake Dam Area

Or — **Reedsville Formation**
Dark gray, olive weathering shale with thin silty to sandy interbeds, black shale of Antes Formation at the base.

Scale: 1:250,000

APPENDIX G

STABILITY ANALYSIS OF OVERFLOW SECTION

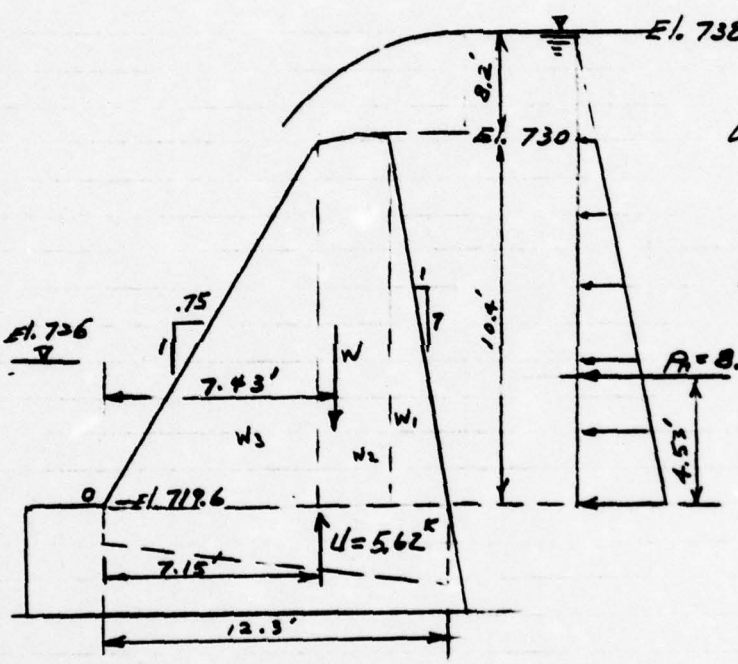
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME Mountain Lake Dam
I.D. NUMBER PA. 28-37
SHEET NO. 1 OF 2
BY KHC DATE 2-5-79

Stability Analysis

Overflow Spillway

Max. Water El. 738.2' at 0.5 PMF



Use
Wt. of Concrete, 150#/ft³
Wt. of water, 62.4#/ft³
Max. Tailwater El. 726.0'
neglect silt affect.
neglect the arch effect.

Check El. 719.6

$P_H = (.0624)(10.4)\left(\frac{8.2+18.6}{2}\right) = 8.70^K$ Moment arm = 4.53'

Wt. of concrete

$W_1 = \frac{1}{2}(1.5)(10.4)(.150) = 1.17^K$ $\ell = 11.3'$

$W_2 = (3.08)(10.4)(.150) = 4.81^K$ $\ell = 9.3'$

$W_3 = \frac{1}{2}(7.8)(10.4)(.150) = 6.08^K$ $\ell = 5.2'$

$W = W_1 + W_2 + W_3 = 12.06^K$ $\ell = 7.43'$

Uplift pressure, use area factor = 66.6 %

$U = \frac{2}{3}(.0624)(10.8)\left(\frac{18.6+6.4}{2}\right) = 5.62^K$ $\ell = 7.15'$

L. ROBERT KIMBALL & ASSOCIATES
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DAM NAME Mountain Lake Dam
I.D. NUMBER PA. 28-37
SHEET NO. 2 OF 3
BY KHC DATE 2-5-79

Vert. Water Pressure at upstream face

$P_V = (.0624)\left[(8.2)(1.5) + \frac{1}{2}(1.5)(10.4)\right] = 1.25^K$ $\quad \ell = 11.52'$

Horz. Water pressure at downstream face

$P_1 = \frac{1}{2}(.0624)(6.4)^2 = 1.28^K$ $\quad \ell = 2.1'$

$\Sigma V = W + P_V - U = 12.06 + 1.25 - 5.62 = 7.69^K$

$\Sigma H = P_H - P_1 = 8.70 - 1.28 = 7.42^K$

slide factor, $f = \frac{7.42}{7.69} = 0.97$ too high

Point of application of resultant, distance from Pt. 0

$$d = \frac{(12.06)(7.43) + 1.25(11.52) + 1.28(2.1) - 8.7(4.53) - 5.62(7.15)}{7.69}$$

$$= \frac{27.1}{7.69}$$

$d = 3.52' < \frac{12.3}{3} = 4.1'$

The resultant force is not within the middle third of the base

F.S. against Overturn $= \frac{106.7}{79.6} = 1.34$